far as these points are concerned, it seems clear that in *Macropus major* the semen passes inwards by the lateral canals, even when the opening into the median canal exists, and in *Osphranter erubescens* that the embryo passes out by the median canal; but in view of the differences of structure and relations of the different parts that have been observed in different genera and species, it is not yet safe to say that these statements constitute a rule for the whole of the Macropodidæ.

5. Contributions to the Natural History of an Annelid of the Genus *Dero*. By Frank E. Beddard, M.A., F.Z.S.

[Received September 25, 1889.]

I have had the opportunity lately of observing the sexual form of a species of *Dero*, which I identify with *D. perrieri*. A large number of these Annelids made their appearance in some water containing *Chara* which I received from Messrs. Bolton of Birmingham; at the end of August all, or nearly all, were sexually mature. As there appears to be no account of the reproductive organs of this worm extant, I think it worth while to publish the present notes. Except as regards the sexual organs, they are for the most part confirmatory of Perrier.

The worms reached a length of about half an inch; they were extremely active in their habits, wriggling about very much after the fashion of a free-living Nematode; the colour appeared to the naked eye of a dark violet posteriorly; in front the development of the clitellum and of the sexual products produced an opaque yellowish-white appearance. The eggs could be distinctly seen and counted with an ordinary hand-lens; they lie behind the clitellum; I observed the number to be almost constantly three. I have made no observations upon the tube, which, according to Perrier ("Histoire naturelle du *Dero obtusa*," Arch. Zool. éxp. t. i. (1872) p. 65) and Bousfield ("The Natural History of the Genus *Dero*," Journ. Linn. Soc. vol. xx. (1887) p. 91) are fabricated by the worms. The fact that they make for themselves an habitation of this kind distinguishes the genus *Dero* from *Nais*, to which all recent writers concur in regarding *Dero* as closely related.

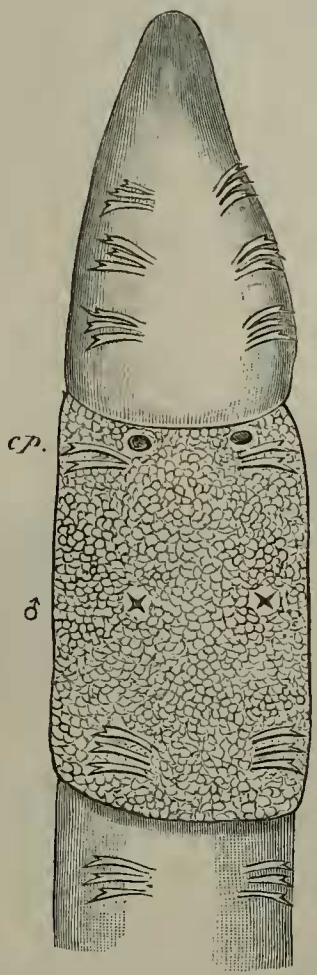
The new facts which are brought forward in the present communication strongly support that view of the affinities of the worm, which may indeed now be regarded as fully established.

The general anatomy of the worm has been described chiefly by d'Udekem ("Nouvelle Classification des Annélides sétigères abranches," Bull. Acad. Roy. Belge, t. xxii. pt. 2, p. 549 *et seq.*), Perrier (*loc. cit.*), and Bousfield (*loc. cit*). Stolč ("*Dero digitata*, O. F. Müller, Anatomicka a histologicka studie," SB. böhm. Gesells. 1885, p. 65), in a paper overlooked by Bousfield and omitted from an otherwise tolerably complete list of papers dealing with *Dero*, has contributed details of importance, being apparently the first to have made use of the section method. I refrain from attempting

a complete list of literature referring to this genus, for the reason that Bousfield has gone into the matter somewhat fully.

Concurrently with the development of the sexual organs, certain of the lower aquatic Oligochæta have been stated to show other peculiarities, so that there is a kind of dimorphism among the individuals. The sexual individuals of *Dero*, in common with other Oligochæta, show no traces of multiplication by budding; connected with this is a regularity in the arrangement of the seta-bundles at the

Fig. 1.



Ventral aspect of sexually mature *Dero*.
cp., spermathecal pores; ♂, male pores.

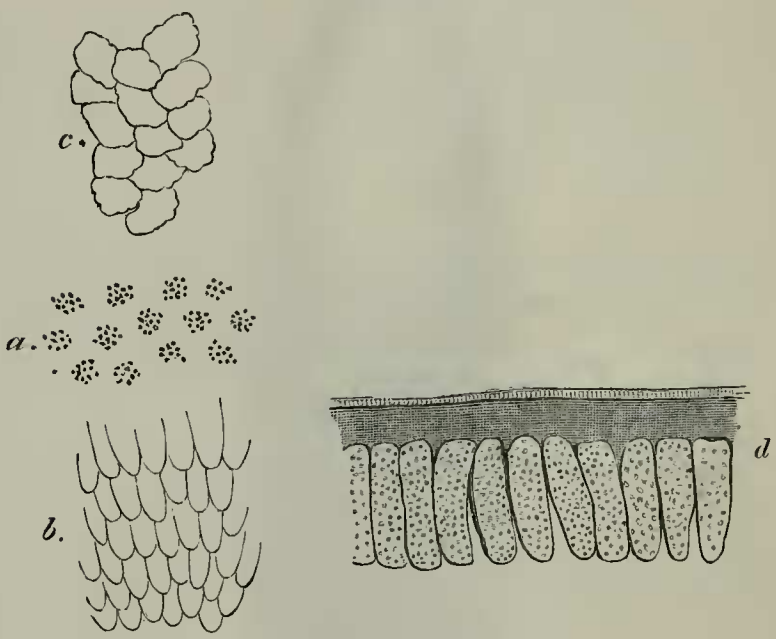
distal extremity of the body. In the asexual form, on the contrary, the continual growth of the posterior groups of setæ appears to produce an irregularity in the disposition of the seta-bundles; the termination of these, for example, in *D. perrieri* (Bousfield) (see

Perrier, *loc. cit.* pl. i. fig. 1) is not clearly defined. In the sexual individuals studied by myself the last segment was only furnished with the ventral bundles of setæ. This character may possibly prove to be of specific value.

It is of some importance to note that budding and sexual reproduction do not take place concurrently in *Dero*, since d'Udekem has asserted that they do in some allied forms.

Among the specimens of *Dero* which I examined were a few individuals which agreed in every particular with the others except for the entire absence of all traces of the branchial apparatus. There was, moreover, no appearance of any injury to this part of the body, and the segments ended off in a perfectly regular fashion. I do not believe that these individuals were a species of *Nais* or any other

Fig. 2.



Clitellar epithelium of *Dero*.

a. Showing granules in cells of developing clitellum; *b*. Fully mature cells, surface view; *c*. Fully mature cells showing crenated margin, surface view; *d*. Section showing granular coagulum which accumulates between epithelium and cuticle.

described allied genus, but I hope to be able to reinvestigate the point if I succeed in keeping the brood of *Dero* alive.

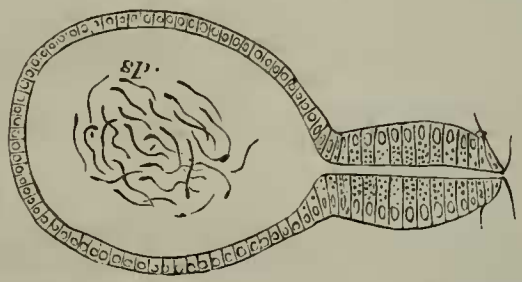
I now pass to the description of the generative organs.

Clitellum.—This modified region of the epidermis was very conspicuous in fully mature individuals by its somewhat greater opacity. Its anterior limits are as nearly as possible bounded by the apertures of the spermathecæ (see fig. 1), posteriorly it extends beyond the 5th seta-bundles; the clitellum therefore occupies three segments,

Nos. 5, 6, 7. The cells which compose the epidermis of the clitellum are much taller than those which constitute the epidermis elsewhere; they are columnar in form and loaded with granules to such an extent that the nucleus (in individuals stained with picrocarmine) was altogether invisible. In a surface-view of a fully developed clitellum the cells often appeared to project as shown in fig. 2 *b*; the cells of the clitellum are at first only occupied by a few highly refractive granules, the cell-outline being very indistinct (fig. 2 *a*). In longitudinal sections of the clitellum (fig. 2 *d*) the unstained cuticle could be easily seen; very frequently the cuticle was separated from the outer extremities of the clitellar cells by a space containing an amorphous substance, which in individuals coloured by picrocarmine solution was stained deep pink. I regard this substance as the product of the activity of the clitellar cells, destined probably for the formation of the cocoon; its accumulation between the cuticle and the epidermal cells seems to be remarkable, even if the secretion has been caused by the stimulation of the glandular cells by the preservative reagent.

Spermathecæ.—There is a single pair of these organs situated in

Fig. 3.



Spermatheca of *Dero* in longitudinal section. *sp*, spermatozoa.

the 5th segment. The apertures to the exterior are placed on the boundary-line between this segment and the 4th, just in front of the ventral setæ. These setæ were constantly two in number to each bundle; I did not observe any variation in this respect in a number of individuals. The number of setæ in the ventral bundles of the three segments anterior to the fifth I found to vary slightly, although usually three. Except as regards their apparently fixed number, the setæ lying behind the apertures of the spermathecæ were in no way different from those of other segments; as in the asexual form, the dorsal setæ of segment 5 and of those preceding it are entirely absent.

The spermathecæ were in every case distended with spermatozoa. The structure is illustrated in fig. 3, which represents a longitudinal section; the narrow duct of the pouch is lined with an epithelium of tall cells, elsewhere the cells of the lining epithelium are much smaller.

All the specimens were so fully mature that it was no longer possible to recognize the position of the *testes* and of the *ovaries*.

On the other hand, the *sperm-sac* and *egg-sac* were filled with the sexual products.

The *sperm-sac* is a single unpaired structure extending through segments 6–8; it was filled with spermatozoa and furnished, as is usual in the Naidomorpha (see Vejdovsky, 'System und Morphologie der Oligochaeten,' Taf. iv. fig. 2, *v.s*; and Štolč in SB. böhm. Ak. 1887, p. 143), with a pair of rhythmically contractile vascular trunks.

The median unpaired *egg-sac* lies behind the sperm-sac, occupying segments 8–10; it contained 2–4 large ova with abundant yolk-spherules. The diameter of the largest ova was fully that of the body-cavity.

The *atria* open on to the ventral surface of the body in a line with the openings of the spermathecæ (woodcut, fig. 1, ♂, p. 441).

It has been already mentioned that there are no setæ developed in the neighbourhood of these orifices; the 6th segment, which carries the atrial pores, possesses only the dorsal pairs of setæ. The apertures of the atria are larger than those of the spermathecæ, and rather more conspicuous, for the reason that they are surrounded by an area upon which there are no glandular cells. The atria are lined by a columnar epithelium, but I could observe no layer of large cells covering these organs externally and forming the structure which has been sometimes termed prostate. No doubt a fine layer of peritoneal cells is present; but this layer was not conspicuously developed as it is, for example, in *Stylaria* (Vejdovsky, *op. cit.* pl. iv. fig. 10).

The *vasa deferentia* appear to run forwards, and to open by a funnel into the 5th segment.

It is clear therefore from the brief and, in some respects, incomplete account which I am able to give here of the reproductive organs of *Dero*, that this genus agrees in all essentials with other Naidomorpha. There is no longer any room for doubt that it has been correctly referred to this family. The three other genera in which the sexual organs have been described are *Nais*, *Ophidonais*, and *Stylaria*. In all of these genital setæ are found upon the 6th segment. *Dero* differs in the absence of these structures. The form of the atrium is more like that of *Nais* than *Stylaria*; it tapers off gradually into the vas deferens, while in *Stylaria* there is an abrupt line of demarcation between atrium and vas deferens.